ADVANCED IRRIGATION TECHNIQUES AND CONSERVATION STRATEGIES

Reducing Irrigated Acreage

Reducing the acreage of irrigated turf is a great way to save significant amounts of water, but managing a low-water-use landscape comes with its own challenges.

SNAPSHOT

This strategy involves reducing the total amount of turfgrass a golf course irrigates. It is a high-impact, medium-cost strategy applicable to many golf courses, especially in arid regions where water is scarce or expensive.

Expected cost	$25K to $50K per acre
Ease of implementation	Large capital project
Potential water savings for affected area	> 50%
Highest potential impact areas	Nationwide

OVERVIEW

Regarding golf course water conservation, no strategy saves more water over a given area than eliminating irrigated turfgrass – so long as the replacement landscape can be maintained with little or no irrigation. Many golf courses irrigate more acreage than is required to deliver a desirable playing experience, even in regions where water conservation is a priority. There are playability, aesthetic and practical reasons why this is the case, along with general resistance to change and the fact that many courses simply do not see a need to reduce their irrigated acreage. However, for golf courses looking to save water, reducing irrigated acreage is one of the most impactful strategies available – but it is not without cost. Establishing a new landscape that can handle reduced irrigation requires investment over multiple seasons, and labor costs can actually increase in non-irrigated areas even if water use is brought down to zero because of high expectations for playability and presentation.

Discontinuing irrigation in an area is easy enough, but figuring out what to replace irrigated turfgrass with and how to manage the new landscape successfully is often quite challenging.

Reducing irrigated acreage requires converting mown, irrigated turfgrass areas to alternative plant and landscape materials that do not require much or any irrigation to survive in a particular environment. These "naturalized areas" can be established in many ways and take many forms. Golfers often envision long grasses in these areas, but shrubs, wood chips and various forms of xeriscaping can all be effective. How these areas are designed, established and managed determines water savings, maintenance costs and the impact on the golfer experience. Discontinuing irrigation in an area is easy enough, but figuring out what to replace irrigated turfgrass with and how to manage the new landscape successfully is often quite challenging.

SCENARIOS FOR USE

The primary reasons for reducing the irrigated acreage of a golf course are conserving water and other resources and/or achieving architectural and aesthetic goals. The relative importance of these motivations will influence the placement, design and maintenance of areas identified for conversion. Out-of-play areas are typically the starting point, but it may be desirable to have non-irrigated areas extending closer to the line of play to optimize resource savings or have a more significant impact on strategy and aesthetics. Remember that the more visible and in-play these areas are, the more maintenance will typically be required to meet golfer expectations.

Where Is the Strategy Typically Used?

Most courses looking to reduce irrigated acreage will first target areas along the property's margins. However, this can create conflict with adjacent property owners, which is a consideration to be aware of. Beyond the margins, areas around tees and between tees and fairways are another common target. These areas do not often see much play, but they are highly visible which can have design and management implications. Areas between holes and behind greens

are also common targets for eliminating irrigated turfgrass. The spacing between holes and the property's topography will significantly impact how practical it is to discontinue irrigation in these areas. Landscape areas around the clubhouse and entry drive do not require irrigated turfgrass for playability, but presentation is important when considering non-irrigated alternatives. These scenarios illustrate the fact that establishing non-irrigated areas may require different approaches in different parts of the property and that design and maintenance of these areas will vary from course to course and even within the same course, depending on the overall goals and resources available.

Reducing irrigated turfgrass acreage has been performed on golf courses across the U.S. Courses in the western U.S. often reduce irrigated acreage to decrease their water costs or focus a limited water supply on primary playing areas. Some areas of the West have incentivized courses to eliminate irrigated turfgrass with rebate programs. In areas where rainfall is more plentiful, creating naturalized areas is often part of architectural or aesthetic changes to a course – or part of an effort to focus more resources closer to the line of play.

Areas between holes, around tees and along the property line are popular targets for turf reduction.

Opportunities To Expand Use

While many courses have increased their acreage of non-irrigated landscape in recent years, there are significant opportunities at many courses to employ this strategy with limited impact on play. Some courses do not have enough irrigated turfgrass acreage to make significant reductions, especially in areas of the Southwest where courses were built with irrigated turfgrass limitations in place. However, a high percentage of courses east of the Mississippi have opportunities to reduce their irrigated acreage, and a surprising number in the west also do.

To put the potential for reduction in context, in the Desert Southwest, golf courses typically irrigate less than 90 acres of turfgrass. For instance, the state of Arizona has had a law since the 1990s preventing any new golf course from having more than 90 acres of turf. Many courses in this area were designed with limited water use in mind and only irrigate 60-70 acres. These courses are still playable and enjoyable, especially if some effort is made to facilitate playability around the margins of the turfgrass area. Many golf courses outside this region irrigate far more than 70-90 acres of turfgrass. While the turfgrass-reduction potential will vary from course to course, a good guideline is to irrigate less than 100 acres of maintained turfgrass. Technology tools like the GPS service provided by the USGA Green Section can help courses objectively assess how much irrigated turf they need to maintain and where reductions can be made with minimal impact on playability.

BENEFITS

Significant Water Conservation

Converting irrigated turfgrass to various forms of naturalized grasses or non-irrigated landscapes can eventually translate to 100% water savings in those areas, depending on the plant materials and environments. In areas where rainfall is sufficient, there is not much reason to irrigate these areas beyond watering in pest control products or germinating seeds. In areas that experience periods of extreme drought, it may be necessary to irrigate naturalized or low-water-use landscapes to keep plants alive, but the irrigation requirement would still be approximately 60%-80% less than what is required to maintain irrigated turfgrass.

Other Resource Savings

Converting areas to non-irrigated or low-water-use landscapes will absolutely translate into less mowing time and fuel savings. It would also be reasonable to expect no fertilizer inputs after establishment and few if any plant protectant applications. Depending on the environment, location on the course, and expectations, there can also be significant labor savings. However, labor costs can just as quickly increase in non-irrigated areas if they are expected to be playable and free of weeds and debris.

Architectural and Aesthetic Changes

Reducing irrigated acreage can transform how a course looks and plays. Often, turfgrass reduction results in greater

definition and texture across the golf course. Naturalized areas can also be used to accentuate or alter the strategy and challenge of a hole. Adding naturalized grasses or low-water-use plants can also be less disruptive and potentially less expensive than other architectural modifications that would achieve a similar impact on strategy. However, it is important to remember that there is a wide cost range for creating these areas depending on the desired replacement landscape.

Turf reduction can help courses achieve architectural and aesthetic goals while also saving water.

Problem Solving

Establishing non-irrigated or low-water-use areas can be an opportunity to solve a range of problems. Many golf courses have areas that they struggle to maintain because of poor irrigation coverage, poor soils, tree-root competition or drainage issues. Converting them from maintained turfgrass to other options typically solves, or at least hides, those problems. Removing turfgrass adjacent to homesites mitigates problems with overspray onto neighboring properties. Turfgrass removal around teeing grounds allows for more-targeted irrigation with improved distribution. Installing subsurface drip irrigation on tees elevates the water savings to a whole new level.

CONSIDERATIONS

Expectations for Playability and Aesthetics

Creating non-irrigated or low-water-use landscapes on a golf course is always more complicated than turning off the sprinklers and not mowing an area. Arguably, the two biggest challenges are playability and presentation issues. Golfers may hear about plans for water-saving areas and envision wispy expanses of tall grass that blow in the breeze but still make it easy to find balls. In reality, very few environments support this situation naturally. It often takes a lot of labor and weed management to produce anything resembling what golfers may have in mind.

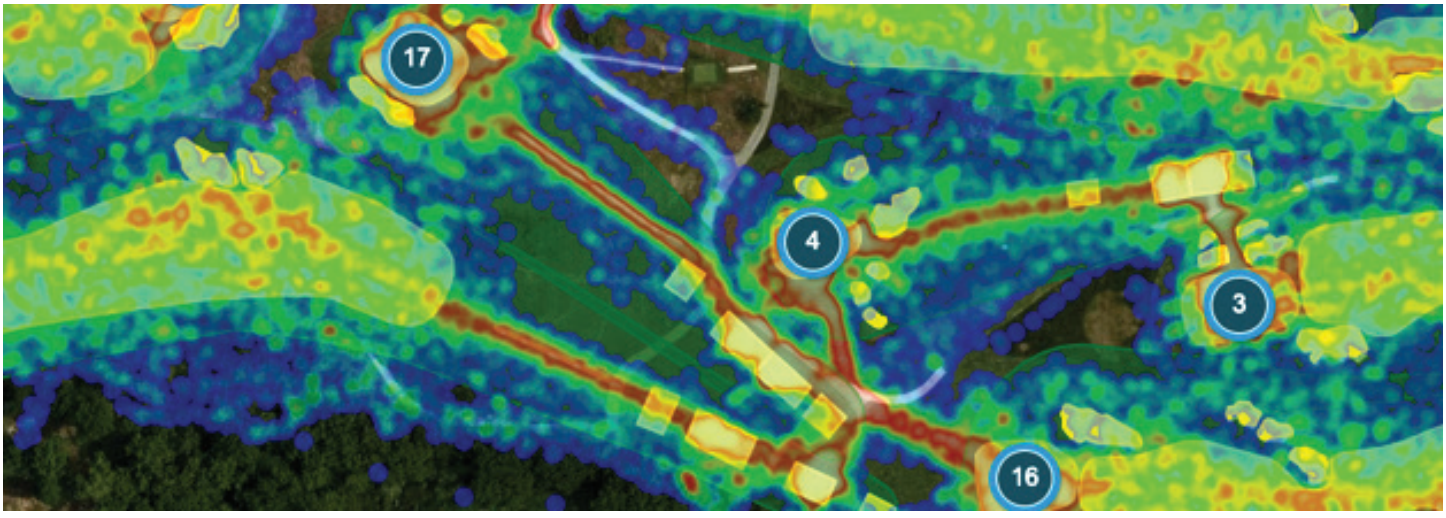
Similar challenges arise with low-water-use areas that feature expanses of bare soil, mulch or rock, which are a more natural fit in many arid and sandy regions. These landscape treatments are vulnerable to erosion and being overrun by weeds. When placed on slopes, mulch and small rocks are prone to erosion. Deep channels can form, affecting playability and potentially depositing soil and debris on adjacent turfgrass areas. Even low-water-use areas with minimal vegetation require continual management, especially if expectations for aesthetics are high.

Regardless of the environment, there needs to be a clear understanding of expectations and reality when creating non-irrigated areas. Achieving meaningful water savings while delivering acceptable aesthetics and playability at a reasonable maintenance cost is no easy task.

Regardless of the environment, there needs to be a clear understanding of expectations and reality when creating non-irrigated areas.

Choosing Areas for Conversion

The success of turfgrass-reduction programs depends heavily on the locations chosen for conversion. Non-irrigated areas fall under less scrutiny when located far from play, but as they come closer to the action they can touch off a steady



GPS technology can show exactly where golfers go during a round and which areas get little use. That information can help courses identify turf reduction areas that will have limited impact on play.

stream of criticism related to lost balls, impact on the pace of play, and overall presentation. It is easy to stand on a tee and think an area is well out of play, but the reality is that golfers end up all over a golf course, and losing a few balls in thick native grasses can wear on anyone's patience. Even if they "shouldn't have hit it there," the reality is that they did, and they are paying customers whose experience matters. This is why it is so important to work with a golf course architect when planning to reduce irrigated turfgrass acreage and to utilize technology that allows us to better understand how golfers of different skill levels typically play a course.

The process of selecting areas for conversion can be guided by using a GPS service. These services provide players with a GPS tracker used during play. The data is then downloaded and used to generate heat maps of where players travel and hit shots on the course. Areas that seldom or never get visited are a good place to start with turfgrass removal.

Dealing With Existing Plant Material

One approach to establishing non-irrigated areas is to let the existing turfgrass grow and stop watering it. This can work well in some regions and for some courses, especially if the expectations for playability and presentation are not high and the focus is on resource conservation – whether that's water, labor or any other input. Unfortunately, the grasses in most rough areas do not readily transform into a desirable low-water-use naturalized area, so the challenge becomes eliminating the existing grasses and preparing the area for something new. Herbicide applications, stripping, tilling and various other approaches are used separately or together to eliminate the existing turfgrass, but it can be stubborn and may continue resurfacing for many years to come. Stripping and/or tilling also gives existing weed seeds in the soil an opportunity to emerge, making weed management a universal challenge among these projects.

Establishing New Vegetation and/or Soil Treatment

Once the existing vegetation has been dealt with, the challenge of establishing the new plant material comes. Almost regardless of the plants selected, there will be a multiyear process of establishment and maturation before a desirable state is reached. Native grasses take a long time to establish, and native shrubs and groundcovers may remain small and unnatural looking for years. In the meantime, weeds, erosion and numerous other issues will complicate establishment. In most cases, the new vegetation will require some form of irrigation during the establishment period. It may be possible to water these areas with existing sprinklers, or a new irrigation design may be required that includes drip irrigation for native plants or sprinklers for overhead watering. Do not expect significant water savings in the early going, and do not remove sprinklers in these areas without a plan for how the new landscape will be irrigated until it is fully established.

Supplemental irrigation must be provided if existing trees are to remain in place. Desirable trees have often declined rapidly when turfgrass is removed around them and overhead irrigation is shut off. Multiple lines of drip irrigation placed in rings around the desirable trees is a good strategy to preserve tree health, although some level of tree loss should be expected with any turfgrass removal project. Another option is adding small pop-up spray heads or bubblers to water trees in turfgrass reduction areas. There has been speculation that trees in previously turfed areas typically have shallower roots and will perform better with overhead irrigation.

Turfgrass reduction areas don't necessarily need to be comprised of long grasses. A mix of plants and various-sized rock and aggregate can be a great solution for extremely dry climates.

Turfgrass-reduction areas may also be designed as bare ground or treated with some form of soil cover, such as mulch or rock. Different forms of mulch have been successfully used to mitigate weeds and erosion while producing an attractive appearance in turfgrass-reduction areas. Depending on the mulch's size, various playability challenges may arise. Mulch often needs to be refreshed annually or biannually, and if color and aesthetics are paramount, then painting may be necessary. Various sizes of rock can also be used as a ground cover in turfgrass-reduction areas. A surface like decomposed granite, with very small rock particles, is better for playability but has greater potential for erosion from wind and water. Furthermore, the small rock particles often get transported onto mown turfgrass by vehicles and golf shoes, which can damage mower reels and blades. Rocks larger than 1 inch in diameter can be used strategically to reduce erosion and weeds but can be problematic when located close to play. Using a combination of smaller rocks on flat areas and closer to play while using larger rocks on slopes and farther from play has worked well.

Developing a Management Program

When establishing any type of non-irrigated or low-water-use area, a successful management program will be a

constant voyage of discovery. Some challenges are easily anticipated, but many unexpected ones will arise, and the challenges will evolve over time. Weeds that were problematic in the early phases of establishment may disappear, only to be replaced by an entirely new set of weeds. The areas that prove problematic from a playability standpoint may not align with what was predicted, and targeted mowing and spraying may be required to address concerns. The frequency of mowing and the amount of weed control may change yearly depending on the weather, and erosion issues may start small and worsen. Managing plant density will be challenging in many environments, and superintendents must continually adjust their programs to produce the desired look. Additional seeding is often necessary for naturalized grass areas, and the desired species will likely evolve. It should become obvious which plants and grasses are most successful and favoring what grows best is a good philosophy.

Some challenges are easily anticipated, but many unexpected ones will arise, and the challenges will evolve over time.

IMPLEMENTATION

Establish Water Conservation Goals

If water conservation is the primary reason for a turfgrass-reduction program, the first step in the process is figuring out how much water the course wants or needs to save. The quick answer will probably be "as much as possible," so it may be more productive to think about a minimum amount of water savings that would make the project worthwhile and work up from there. Once a target savings range has been identified, the next step is understanding how much irrigation different playing surfaces receive in a typical year. Some courses have this data readily available, but others may not. Knowing how many gallons per acre are applied to rough, fairway and landscape areas in an average year will help you identify target areas and calculate when turfgrass removal has reached the desired level. It is also important to factor in the irrigation requirements of the new landscape that will replace irrigated turfgrass. Otherwise, actual water savings will be overestimated.

Identify Target Areas

Once a water-saving goal has been identified, it is time to select the target areas for turfgrass reduction. The optimal design for each course will depend on the goals for resource savings, the desired playability and aesthetics, and the budget for conversion and long-term maintenance. If water conservation is the primary goal, converting more irrigated area will mean greater savings. However, remember that many courses have experienced increased labor costs with conversion to low-water-use areas. It is important to understand what the expectations are and where the balance lies between water savings and labor costs.

Regardless of the goals or priorities of a turfgrass-reduction program, it is always wise to work with a qualified golf course architect. They will be able to guide a facility through the many trade-offs among playability, strategic value,

aesthetics and potential water savings. These decisions will determine the success or failure of turfgrass reduction in the eyes of golfers, and if they are not happy it can mean higher maintenance costs or even complete reversal of certain areas back to irrigated turfgrass.

The first places to target are the "out-of-play" areas, but what exactly that means is not always easy to define. Anyone's experience as a golfer has shown them that shots end up just about everywhere on a golf course, even places that most would consider completely out of play. This is where objective tools like mapping golfer traffic with GPS trackers can be a tremendous asset. Observing where golfers have and have not gone over an extended period can help identify conversion areas that would truly have a limited impact on play. If going beyond those areas is desired, at least it will be with a clear understanding of what the impact on play is likely to be.

Working with a golf course architect to plan turf reduction areas will help balance water conservation goals with the impact on strategy and aesthetics.

The layout of the irrigation system is also a key consideration. It is important to either lay out turfgrass-reduction zones with respect to the location of existing heads or plan for changes to the irrigation layout. If turfgrass-reduction zones do not correspond to the location of the heads, the result might be areas of maintained turfgrass that are too dry, or naturalized areas that are too wet. If a choice must be made between these two options, dry areas of maintained turfgrass are usually preferable from a playability and aesthetic standpoint as they will act as a transition zone between irrigated turfgrass and non-irrigated areas. Sprinkler overthrow into turfgrass-reduction areas should

be avoided as much as possible because this can promote excessively dense vegetation, weed growth and undesirable aesthetics.

When reducing irrigated turf without changing the existing irrigation, the best thing to do is coordinate the new turf-reduction limits with the existing sprinkler head layout. When this is not possible, work with an irrigation designer to add backup heads or try to have a "rooster tail" nozzle spraying out the back of an existing head to irrigate any turfgrass area that does not correspond perfectly with the sprinkler layout. If a new irrigation system is being planned, that is an excellent opportunity to consider turfgrass reduction because the system can be laid out around the new grassing lines.

Another critical factor in locating turfgrass-reduction areas is the treatment that will replace irrigated turfgrass. If the turfgrass-reduction areas will be relatively playable – like sandy hardpan with scattered grasses and groundcovers – there is more leeway to encroach on the line of play. If turfgrass-reduction areas will be unplayable – like high-density plantings or larger rock – they will likely need to be farther from the line of play to minimize conflict with golfers. Even areas that seem out of play will come into play more often than anyone would like to admit, so it is usually better to err on the side of caution. A great example is the area directly in front of the tees. Many golfers would say it is out of play, but we've all seen our fair share of topped tee shots and nobody likes looking for a lost ball 20 feet in front of the tee.

Turfgrass reduction is not typically something that needs to happen all at once, and trying to do too much too fast can lead to many avoidable issues.

When laying out turfgrass-reduction areas, remember that there can be different treatments depending on the proximity to play. Areas on the far periphery of the golf course can potentially receive less maintenance or a different planting scheme than high-visibility or high-traffic areas. Identifying these differences can help optimize overall resource conservation. Converting smaller test areas that are well out of play before working closer to the line of play can help avoid problems and build consensus around different approaches. Turfgrass reduction is not typically something that needs to happen all at once, and trying to do too much too fast can lead to many avoidable issues.

It is often best to allow the golf course architect to identify what they initially believe would be an ideal turfgrass-reduction plan without worrying too much about the irrigation design or other potentially limiting factors. Once that is established, the review process can begin to consider the amount of irrigated acreage removed, the expected water savings, the irrigation design, aesthetics and playability, and maintenance considerations like the location of trees or problematic turfgrass areas.

Decide Who Will Do the Work

Turfgrass removal projects are often completed when the golf course is busy and the turfgrass is actively growing. Therefore, the maintenance team is busy with routine maintenance. This is why it is often best to use a skilled contractor to complete turfgrass-reduction projects. However, many courses have used a hybrid approach where the golf course maintenance team makes the herbicide applications to control existing turfgrass and then assists the contractor with cleanup, irrigation adjustments and plantings. Some complete the work in-house to save

money, but the reallocated labor will come at the cost of what can be completed on the golf course. How low-water-use areas are designed will play a significant role in this decision. Large areas of complex landscaping will almost certainly require the assistance of a contractor and/or additional maintenance staff, whereas smaller areas that are established by simply discontinuing maintenance can be quickly done in-house.

Select Alternative Plant Materials, Landscaping or Soil Treatment

There are several key considerations in selecting alternative plant materials and soil treatments when water savings is the highest priority. Species and planting density have a big impact on potential water savings. Mistakes have been made by overplanting or using plants that consume more water than other options. For example, planting inappropriate trees in environments where they require irrigation can lead to more water use than turfgrass over a given area. However, planting appropriate trees could have environmental and playability benefits. Any new trees in turf-reduction areas should be able to tolerate minimal to no irrigation once established.

Before selecting plants for low-water-use areas, it is wise to visit with the local university cooperative extension agents, local and state water authorities and water purveyors who likely have an extensive list of well-adapted, low-water-use plants. The golf course architect, a landscape architect and a regional USGA agronomist will also be good sources of ideas for vegetation selection and placement. Visit nearby courses that have undergone similar turfgrass-reduction projects and discuss the advantages and disadvantages of their chosen treatment. Begin to evaluate ideas years before the project, if possible. Select one or several out-of-play areas on the course, install different treatments, see how they perform and solicit golfer feedback. These trials are invaluable for becoming more comfortable with the conversion process, subsequent management and the impact on playability. Experience demonstrates that there is no easy, cookie-cutter answer for what to plant or how to treat the soil in turfgrass-reduction areas. There are trade-offs involved in every option. The following is an overview of the most common treatments used to replace irrigated turfgrass on a golf course.

Testing various planting options before implementing a turf reduction program will help you evaluate aesthetics, playability and overall performance.

Naturalized grasses and ground covers

"Naturalized" is a loosely defined term to describe tall grasses that may or may not be native to the area, but are expected to use less water than maintained turfgrass – or no water at all, depending on the climate. If this type of planting is the preferred option for replacing irrigated turfgrass, it is best to start small with demonstration areas planted using grasses identified by local experts. Naturalized grasses will establish slowly and often will not achieve the desired look until 3-4 years after planting. It may be advisable to create some form of transitional area between the maintained turfgrass and tall naturalized grasses to help with playability and pace of play. Some courses mow the margins of naturalized grass areas in key locations, whereas others establish buffers with no vegetation at all. The USGA Green Section Record article "Native Grasses and Ground Covers as Turfgrass Alternatives in the Southwest" contains lists of suitable plants for arid climates and results from studies evaluating their use in places like Arizona.

Rock and mulch

Various sizes of rock and mulch are commonly used in turfgrass-reduction areas, especially in the Desert Southwest. In 2024, costs for this type of landscape rock spread 2 inches deep range from $18,000 to $25,000 per acre. The type of rock used is typically 0.375-inch diameter or less, and most often, courses use 0.125-inch diameter or less because it easily compacts and golfers can hit a recovery shot with relative ease. However, the small rock will erode with wind and water, especially when placed on slopes. Some courses have successfully used larger landscape rock or "rip rap" in these scenarios, but costs are significantly higher for the larger rock. Some courses in dry climates would rather repair erosion after the infrequent rain events rather than spend additional money on large rocks. Where water flows into the course from off-site, such as from homesites or streets, it is often best to use larger rock or leave these areas as turfgrass for erosion mitigation.

A mix of mulch and plantings can be a playable and attractive option for turf reduction areas.

Mulch is another commonly used option in turfgrass-reduction areas. Locally sourced mulch is best, and some courses with an abundance of trees may be able to keep pace with mulch replacement by chipping their own material on-site. Mulch is often applied 2-4 inches deep and will likely need annual replenishment to maintain this depth. Mulch helps mitigate soil erosion, is relatively easy to play golf from, and is easy to find golf balls in.

Landscape plantings

Low-water-use plants with slow growth habits are best for turfgrass-reduction areas. Many state water agencies supply a list of low-water-use plants for regions within their state. It is often best to plant small, 1- to 5-gallon pot plants at wide spacing. While this aesthetic often elicits complaints initially because it appears “barren,” in a few short years the mature look will be appreciated.

Bare soil

Maintaining areas of bare soil or very sparse vegetation instead of turfgrass is also an option. In arid environments, this option works relatively well since no irrigation is required, weed pressure is minimal and heavy rains are infrequent. However, in areas that receive more than about 15 inches of annual rain, weed pressure will be significant without any competition. A good preemergence and postemergence weed-control program will be necessary to maintain a clean appearance. A box blade is frequently used in bare soil areas to knock down small weeds, smooth out ruts from erosion, and create a smooth and attractive appearance. While a bare soil treatment is less costly to install, maintenance is necessary depending on the level of expectations. Sites with sandy soil and/or limited rainfall have a better chance of maintaining reasonable playability in these areas. Heavy soils with no plant cover can quickly become a quagmire if rainfall is frequent.

Bare soil can also be an alternative to irrigated turfgrass, especially in areas that receive very little rainfall and don’t have much slope in the terrain. Bare ground in wetter climates will have issues with mud, erosion and weed pressure.

Expected Cost and Timeframe

The cost of creating turfgrass-reduction areas varies widely depending on the treatment chosen. Costs can range from as low as $12,000 per acre to over $180,000 per acre. The least-expensive projects are completed in-house with no soil preparation work and minimal plantings. These projects simply involve killing the existing turfgrass with one or more herbicide applications and installing some form of soil cover, or even leaving bare soil. Higher-end projects include a golf course architect and landscape architect, a contractor to complete the turfgrass removal and replanting process, and significant irrigation modifications.

Eliminating the Existing Turfgrass

Courses use a variety of methods to remove existing turfgrass and, as might be expected, results are highly variable. Replacing a bermudagrass area can be as simple as one herbicide application followed by covering with several inches of rock. Initial costs for this process are minimal compared to others, but courses need to budget for a regimented spray program to control bermudagrass reemergence. If the water is turned off in these areas and plantings are minimal, the results are surprisingly good. The expectation should be to manage turfgrass reemergence for three to four years with a routine herbicide program.

For a more robust turfgrass removal program, especially where warm-season grasses are present, two or three herbicide applications are necessary and may be followed by mechanical removal. A fall herbicide application is suggested to injure the warm-season grass prior to winter dormancy. Resume applications the following spring once there is regrowth. A good guideline is to plan on three herbicide applications spaced approximately three to four weeks apart to allow enough time for warm-season grass regrowth between applications. If replacement plants receive drip irrigation or no irrigation, warm-season turfgrass reemergence is less likely. However, if the area is to be planted with naturalized grasses that require irrigation, a more thorough chemical program is necessary to minimize warm-season grass reemergence. Cool-season turfgrass is easier to control than warm-season turfgrass. One or two nonselective herbicide applications will suffice in most cases.

Eliminating the existing turfgrass can be a significant challenge in creating low-water-use areas. One or more herbicide applications will likely be required, depending on the existing turf and the replacement landscape that is planned. (USGA/Kohjiro Kinno)

Mechanical tools such as a box blade can be used to remove turfgrass for disposal. The removal process is usually most efficient if the sod is cut first and then scraped into piles. Alternatively, healthy sod can be harvested and used in strategic areas on the golf course. Especially for warm-season grasses, herbicides

will be necessary approximately three weeks after stripping when the grass reemerges. Minimal soil preparation is strongly suggested. Removing more than the top 0.25 to 1 inch of surface material is not necessary nor recommended. More-aggressive removal or rototilling results in greater weed pressure and unnecessarily increases costs. If mulch or aggregate material is going to be placed over the turf reduction area, an edge 1-2 inches deep should be created along the turf margin and tapered into the turf-reduction area to tie-in the landscape material and prevent it from spilling into the maintained turfgrass.

Healthy turf in removal areas can be harvested and used elsewhere on the golf course. Allow some time after stripping for any regrowth and then treat with herbicides. (USGA/Kohjiro Kinno)

Establishing the New Landscape

Irrigation

Independent irrigation of the turfgrass and turfgrass-removal areas is essential for a successful project. While it is ideal to eventually discontinue watering in turfgrass-reduction areas, in most climates it is a good idea to leave sprinklers in place when planting naturalized grasses for the establishment phase and for supplemental water if necessary during the summer months. Where woody vegetation is installed, drip irrigation is often used. Experience has shown that a riser made from schedule 80 PVC pipe and equipped with a pressure-regulated drip emitter is superior to a flexible pipe and “spaghetti” tubing, which are easily dug up and damaged.

Maintenance is often a challenge along the margin between irrigated turfgrass and turfgrass removal areas. Overspray from the turf areas contributes to weeds and undesirable growth in the naturalized areas. Or, if the sprinklers are too far from the edge of the naturalized area, courses end up with dry turf. Having part-circle irrigation heads properly placed along the perimeter of the irrigated area is the first step in managing this issue, and courses can expect to move some heads around to accommodate the new planting scheme. Making sure these heads stay

properly adjusted is another important step, but all it takes is some wind to create enough overspray to cause problems. A novel idea is to install subsurface drip irrigation in a band approximately 10 to 12 feet wide into the remaining irrigated turfgrass. The overhead sprinklers can then be offset the same distance toward the line of play, thus significantly reducing overspray and water waste in the turfgrass-reduction areas. Some courses have found success managing a 6- to 10-foot-wide strip of bare ground, rock or mulch with no vegetation adjacent to the turfgrass. This facilitates easy spraying for weed control and allows golfers to find errant shots that just missed the turf. This type of treatment will fit better in some environments than others.

Ideally, turf reduction boundaries will correspond with sprinkler locations so that heads can cover the irrigated turf without throwing water into the turf reduction area.

Soil preparation and planting methods

It is not necessary to rototill the soil to establish naturalized grasses or other vegetation. In fact, the less soil disturbance there is, the better. Soil disturbance increases the risk of erosion, and it can bring unwanted weed seeds to the surface. A good strategy to establish naturalized grasses is hydroseeding with no soil preparation. Otherwise, utilize an aerator with solid tines on a tight spacing to create shallow (0.25 to 1 inch) holes to catch and hold the seed.

Maturation

Newly introduced turfgrass-reduction areas usually receive the greatest amount of discussion and complaints during the first year. Grasses or plantings can look sparse at first, and weed issues are to be expected. Erosion may also be a problem as the new plantings establish. All of these factors can concern golfers. Naturalized grasses will require the greatest amount of grow-in time, typically three to four years before reaching maturity. These species are significantly slower to establish than turfgrass from seed. While turfgrasses may germinate in five to seven days and produce a dense stand in only a few months, naturalized grasses often require five to six months or more. Furthermore, turfgrass-reduction areas are often located on steep terrain with a variety of sun exposure, complicating establishment. It is usually necessary to reseed areas, likely comprising 30% or more of the entire turfgrass-reduction acreage. Some areas will need reseeding more than one time and over multiple years. Weeds will emerge and reemerge and compete with the desirable species. Establishment and management can be frustrating for several years, and patience is key. Eliminating cart use in these areas is essential.

People need to be prepared for a multiyear establishment and maturing process before turfgrass-reduction areas really start to look good.

Establishing shrubs and trees with drip irrigation is often less complicated than establishing naturalized grasses. Probably the best piece of advice is to start with small plants and ample space between them. Allow several years for the plants to grow and mature. Small plants will outgrow larger plants eventually, and they are less expensive to purchase and plant. Small plants on an appropriate spacing will look sparse initially, and golfers may express concern. People need to be prepared for a multiyear establishment and maturing process before turfgrass-reduction areas really start to look good. Set realistic expectations, have patience, make irrigation adjustments, evolve with what works best and replant when necessary.

Long-term maintenance

Maintaining native grasses and other plants like wildflowers to continuously provide a natural appearance will require monitoring and considerable labor resources. The same is true of landscape plantings with woody species. A wide variety of weeds will encroach upon these areas and require timely maintenance if they interfere with play, aesthetics or functionality. Weed control is a complex challenge in most types of turfgrass-reduction areas because it can be difficult to apply effective postemergence products broadly without damaging the desired plants. Backpack spraying and manual weed pulling are common tasks in turfgrass-reduction areas, especially if expectations are high for presentation and playability.

Developing an effective mowing program for naturalized grass areas is an important part of long-term maintenance and can greatly assist in managing weeds and overall density. The timing and frequency of mowing these areas will vary from year to year depending on the weather and weed pressure. In wet years, it may be necessary to mow down naturalized areas earlier and more often than planned to keep them manageable. This may not be the preferred aesthetic, but weather and soil conditions will always determine how best to manage naturalized grass areas. Selective mowing in key locations is another common management strategy to maintain playability and minimize complaints. Oftentimes, courses will mow one or two passes adjacent to playing areas to help speed up the pace of play.

Managing weeds is a challenge in turf reduction areas. If there are high expectations for weed control, backpack spraying and hand pulling will likely be necessary.

Erosion is another challenge that will require ongoing maintenance. It is very common for courses to install remedial drainage features in turfgrass-reduction areas once erosion issues reveal themselves. Depending on the situation, creating ditches and retention basins may be enough to solve the problem; in other situations, water will need to be captured and carried away in drainage pipes. Adjustments to the planting plan may also be necessary in areas where erosion becomes a problem. The desired plants may lack the ability to keep soil in place, so it may become necessary to look for other low-water-use options or to restore turfgrass in areas where low-water-use plantings have proven unsuccessful.

Being flexible with the composition of the plant community in turfgrass-reduction areas is an important part of managing costs and expectations. Some weeds are problematic and must be managed, but others may not really be an issue and can be tolerated. The planting scheme initially imagined will almost certainly evolve. Some plants and grasses will thrive in some areas and fail in others, or weeds may become the dominant plant in some areas without causing much of an issue. In fact, a hardy population of weeds may save certain areas from total failure. Courses

should try to be as pragmatic as possible when it comes to managing the plant community in naturalized areas, otherwise maintenance costs can spiral upward.

TIPS FOR SUCCESS

Beware of the impact on the labor budget.

Many courses have found that eliminating irrigated turfgrass areas saves water yet it leads to more staff time spent in those areas for weeding, selective mowing and other tasks. How significant the labor impacts might be goes back to the goals of the project and the expectations – and a recognition that expectations may change over time. Golfers may say they are comfortable with weeds and lost balls in "out-of-play" areas, but once they discover how frequently they hit shots into those areas they often demand more maintenance. Developing a landscape design and maintenance program in some test areas is a good strategy to get everyone on the same page and evaluate the labor impacts of turfgrass reduction.

If there are high expectations for presentation and playability in naturalized areas, labor costs to maintain those areas can be higher than for mown rough.

Do not be afraid to treat different areas differently.

Not all turfgrass-reduction areas need to be designed, planted or maintained in the same way. Certain high-visibility and high-traffic areas will likely require more resources to provide acceptable quality, whether they are planted with native grasses, xeriscape or any other treatment. In areas farther out of sight, there may be opportunities for less-intensive maintenance that leads to water conservation and labor savings when compared to mown, irrigated turfgrass. Identifying the distinction between in-play and truly peripheral areas can help optimize many decisions.

Fine fescue is not always the answer.

Many golfers imagine seas of long grass blowing in the breeze when they think about "naturalized" or non-irrigated areas, but this aesthetic is not native or easy to maintain in most areas. Trees, shrubs, small plants and groundcovers are what would naturally grow in most places, and going in a different direction from the native vegetation can require additional resources. This is not to say that native vegetation is easy to establish or maintain – or that it will necessarily deliver the desired playability and presentation – but it is important to at least consider a broader range of planting options when it comes to turfgrass-reduction areas than grasses which may or may not be native to a particular area. A good way to start planning turfgrass-reduction areas is to look at non-irrigated areas along roadsides or in parks to see what is growing there. Plants that thrive in those environments could be a relatively low-maintenance option for turfgrass-reduction areas on a golf course.

Mowing is part of management.

Turfgrass-reduction areas tend to be more problematic when they are too thick rather than too thin. Golfers may complain about poor coverage or erosion, but if they can find and play their ball the complaints are generally fewer. Unfortunately, the vegetation in turfgrass-reduction areas often gets too thick, leading to a poor aesthetic and lost balls. This is especially true in areas with regular rainfall and soils that retain moisture well. While the goal may be having long grass with seedheads visible throughout much of the year, a rainy stretch of weather can make turfgrass-reduction areas grow out of control, and there's nothing wrong with mowing them down to more manageable heights. The desired contrast from rough areas will still be achieved, just with fewer complaints about weeds and lost balls. This same logic can apply to routine management. If resources can't keep up with weed control and density management in non-irrigated areas, it might be better to just mow them at the highest possible height several times each year to keep things as playable and presentable as possible.

Mowing is an important part of managing naturalized grasses in turf r eduction areas. If a course is having issues with density or weeds in these areas, more-frequent mowing may be the answer.

Be careful with turfgrass reduction in front of the tee.

The area around teeing grounds is often a prime target for turfgrass reduction, but if new plantings are likely to produce lost balls, it may be better to avoid the area immediately in front of most tee decks. While truly expert players are unlikely to top a tee shot, many other players routinely have this issue, especially if there is a lot of tall grass right in front of them. Losing a ball after a poor tee shot is particularly aggravating and golfers are more likely to spend extra time looking for a lost ball close to the tee, even if they have little chance of finding it. A corridor of mown rough in front of the tees, even if it is not irrigated, can be very helpful for keeping things moving and minimizing controversy about non-irrigated areas.

Hardpan is not necessarily low maintenance.

Areas of bare ground within a turfgrass-reduction area can be excellent for playability, but depending on the soil type and climate they can be hard to maintain. In areas that receive consistent rainfall, bare ground will be under continual weed pressure. If those weeds tend to be low-growing and playable, they might be acceptable. If they tend to be tall, dense or aggressive growers, they can become a real problem in areas that were intended to be exposed soil. Erosion can also be an issue in hardpan areas depending on the nature of the soil, topography and climate. Sandy soils make for excellent, playable hardpan but are also vulnerable to erosion from heavy rains. Steep slopes and intense rainfall will exacerbate erosion issues further. If hardpan soil is desired as part of a turfgrass-reduction area, selective weed control and erosion repair should be planned as part of the long-term maintenance program.

Turfgrass-reduction areas may still require irrigation.

Most turfgrass-reduction options require some irrigation during establishment and maturation. In arid climates, irrigation may be required during the summer months, although significantly less than maintained turfgrass would require. Watering-in preemergence weed control applications and other pest control products may also be necessary. Accounting for these irrigation needs is an important part of success. Many courses have mistakenly viewed these areas as “non-irrigated” only to find themselves running hoses and portable sprinklers from fairway quick couplers during establishment and beyond. Having some form of automatic irrigation in turf reduction areas is a valuable and potentially necessary asset.

Build golfer and homeowner support.

For most courses, gathering golfer and homeowner support for turfgrass reduction is crucial to the project’s success. While some golfers living on the course may support turfgrass reduction, when the project lands in their backyard the sentiment may change. Building support for turfgrass-reduction projects will take time, several years in some instances. But perseverance and gathering support from industry professionals inside and outside of the facility will go a long way. The facts that coincide with turfgrass reduction are powerful. Courses facing escalating water costs or water restrictions may not have much choice, and golfers and homeowners will eventually support turfgrass reduction if the alternative is to shut down the course and parcel the land into real estate. Courses have garnered support from being good neighbors. Reach out to each and every homeowner in the community, especially those along the course, and explain the reasoning behind the decision to remove turfgrass.

Keep up to date with trimming, pruning and vegetation removal.

Volunteer plants and trees will establish themselves in almost all turfgrass-reduction areas. In some cases, the vegetation will be welcome and provide additional texture, vertical definition and interest to the golf course. However, dense trees and shrubs may obscure views across the course, block air circulation and shade nearby turfgrass. Deferring trimming, pruning and removals for several years will result in dense vegetation that looks unsightly, slows the pace of play and can attract unwanted pests. The longer you wait to manage volunteer trees and shrubs, the more challenging and expensive it will be to return the area to the desired appearance.

Tell the story of water conservation.

Conserving water while preserving a functional, attractive and playable golf course is a win-win for the facility, the neighborhood, the state, the region and the golf industry. Document the savings and share that story with public leaders. Think beyond sharing with golfers and homeowners and reach out to the water purveyor and local, state and regional government officials. Sharing the success of water conservation strategies can help facilitate financial and political support for these projects from water purveyors and other government authorities.

BMP CASE STUDIES

"Naturalizing Areas Helps Maximize a Limited Water Supply"

USGA Green Section Record, 2017.

A golf course in Massachusetts with a limited groundwater allocation struggled to manage periods of summer drought, causing noticeable turfgrass loss and a decline in playing conditions. A decision was made to convert approximately 15 acres of maintained rough to naturalized fine fescue that would not require irrigation once established, nor affect play. The turfgrass reduction project contributed to a 4-5 million gallon reduction in annual irrigation and made more water available for primary playing areas, which helped address limitations on water use.

"Native Grasses Yield Water Savings"

USGA Green Section Record, 2017.

An Arizona golf course went from 220 acres of irrigated turf to 80 acres as part of a renovation designed to improve sustainability and decrease water use. 140 acres of formerly irrigated turf was converted to naturalized grasses and native desert vegetation, leading to tens of millions of gallons in water savings each year.